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THE NEWER DEMANDS ON PHYSICS AND PHYSICS TEACHERS DUE TO THE WAR[1]

At this time when the daily press all over the world is filled with statements and exciting accounts, proving beyond all doubt that the present war is a war of science, we, who pose as champions of so basic a branch of science as physics, would be guilty of gross carelessness should we not in some way take advantage of this unprecedented world-wide advertising. As expressed recently by the president of The American Institute of Electrical Engineers, "a flood of scientific and technical accomplishment has swept over the face of the earth."[1a] and it is just such a description of our world war that the physicit must consider if he is to aid in bringing about the end—or assist in its indefinite continuation, if need be—or if as a teacher he is to prepare his pupils for the new wartime and peaceful duties sure to fall to the lot of every citizen in the newer civilization now passing through the agonies of its birth.

What are some of the points where immediate attack by physics teachers may be expected to result in compensatory results to the nation? What are the demands on these apostles and on their science? If any, what are the opportunities for the promulgation of this science, accompanying, or growing out of this opportunity for service?

There are two general aspects to the whole inquiry. One is that of the imme-

[1] Read before the Ohio Academy of Science, Columbus meeting, May 31, 1918.

[1a] *Electrical World*, July 7, 1917, p. 5.

diate service to the nation that the information or ability of the physicist may afford. Of this I need say nothing. The other, and one which is not clearly separable from the first, is the question of our opportunity to take advantage of the world's awakening to the realization of the value of fundamental science, and establish as never before an interest in that broad domain closely analyzed only in the study of physics. Though the utilitarian motive may always be one of the chief recruiting agencies for any fundamental science, there is now every reason to believe that in the immediate future it will be glorified by an accompanying inspiration—for this world-wide "flood of scientific and technical accomplishment" which is now identified with the war, and which will attain to even loftier heights in ending the war—this upheaval is accompanied by one of no less importance for the future—the sudden unrest and dissatisfaction of the average individual with his own scientific appreciation. To keep pace with events even now makes an effort toward progress along this line imperative. Survival hereafter may be synonymous with successful competition in a new world where scientific method based upon ever-increasing scientific information is the dominating factor in existence. Hence it is that we, simple teachers of physics, have now an opportunity and a duty, probably unique.

Even against the advice of the President and other government authorities, our students, though below draft age, are rushing into the war because there have come to them ever louder the echoes of a larger life now centered in the great struggle, which have brought with them to the youthful mind the sudden realization of the fact that his academic world is not the most actual one, that he is not learning in the most direct manner of the things that count, and he is truly justified in answering the call to enter that world where his interest may be focused on things felt to be real.

What can be done that will help him when he goes, or to strengthen him in the most efficient manner while he stays? Those who leave must go with all possible preparation; those who remain behind must be well armed for the equally important struggle here—and the beginning steps for the teacher, for example, the teacher of physics, are clearly indicated by the sudden development of a host of new questions of interest in themselves, and which may serve to entice the beginner through uninviting portals into a new storehouse of endless benefits for him and all with whom he may come in contact

Let us consider some of the more common questions specifically, in approximately the general order in which we have been accustomed to classify their kind.

To begin with, we may take aviation. Here we have ample material for the discussion of such good physics that even the most conservative text-book-repeating pedagogue can not object. To the student it affords a most impressive illustration of the relation of action to reaction, also of the omnipresence of friction, and at the same time of its indispensable utility—and again, of the universality of gravitational attraction. There is also the question of the non-ricocheting shell[2] that will dive and not glance from the surface of the water when directed toward a more-or-less submerged submarine. Such devices can not be explained to the ordinary class completely, but the nature of the solution of the problem can be indicated with sufficient detail to increase rather than chill the student's interest. He asks about the various types of unsinkable ships, and even

[2] *Scientific American*, February 9, 1918, p. 125.

though he may not now know the actual details of the construction of such a craft, he soon sees the general requirements to be satisfied. Archimedes's principle acquires a new interest. The laws of fluid pressure become more than text-book formulations of rare phenomena. His knowledge of the fact that water is practically incompressible enables him to criticize constructively such a story as told by the preacher who pictured to his horrified audience the wrecked *Lusitania* coursing the ocean ways at some far-down level below which no ship can ever sink. He sees new light when it dawns on him that even "the whys and why-nots of deep sea diving"[3] come well within the field of discussion of an ordinary course in physics. Then again, the nation-wide interest in the conservation of ammonia for the manufacture of explosives lends new color to the whole subjects of heat and of gas phenomena, from the simple laws of Boyle, of thermal expansion, of heat exchanges, to the applied side of refrigeration. Perhaps for the first time he sees the reason for having a kinetic theory of gases.

Next, perhaps, may come the field of sound, commonly considered as one of the minor branches of physics, a judgment somewhat justified, for in the more elementary texts such as used in the high schools, this subject is allowed only from six to nine per cent. of the space in the book. And why? Surely not because its phenomena are fewer than those of the other phases of our science, not because they are of less importance, but rather, let us say, because they are less understood. After the United States entered the war and a census of our scientific abilities was taken, American physicists had to admit that after all no one knew very much about sound. The great sources of information were the works of Helmholtz and Rayleigh, treasure stores, to be sure, but limited in their applicability to practical problems, and containing little that could be recast into any form digestible by either practical workers or students. And then came real problems, thick and fast. Methods were sorely needed for locating the enemy in the sea and in the air. In all of these directions some success has been attained, but until details are made public the physics teacher will have to supply what he can by way of suggesting the probable solutions of the problems. He knows something of the possibilities, something of the conditions that must be satisfied, and he is, or at least should be, free from the danger of the illogical reasoning of which others may be guilty. For example, he can assist his pupils in understanding how it is that successful methods can be devised for insulating a whole region against air-sounds and earth-sounds.[4] Doppler's principle finds a new illustration in the phenomena produced by a near-by projectile.[5] Then there are those other questions, not so easily explained, such as those about the causes of distinct sound areas separated by a zone of silence which may be several miles in width, although the disturbance has originated at a single source, as in the case of some of the explosions in East London.[6] Such questions surely make new demands on the investigator and teacher, but at the same time they afford unequalled opportunities for enlisting the interests of many to whom the subject has been wholly foreign.

For the first time artificially produced sounds are observed to have traveled as

[3] *Scientific American*, January 12, 1918, p. 60.

[4] *Elekt. Zeits.*, 38, pp. 410–441. Also *Science Abstracts, A*, No. 180, February, 1918.

[5] *Science Abstracts, A*, No. 528, 1917.

[6] *Science Abstracts A*, No. 1295, 1917. *Phys. Zeit.*, 18, pp. 501–504. *Science Abstracts, A*, No. 183, February, 1918.

much as two or three hundred kilometers[7]—how, we can not say, but probably in no manner different from that in which lesser disturbances are propagated. And this is typical of a fact the teacher should not overlook. Scientific progress is the discovery of more truth, rather than the contradiction of laws already clearly established.

No one who has had the pleasure of seeing some of the beautiful slides, such as those from photographs by Professor Foley, showing sound waves in all stages of development—birth, growth, reflection, refraction—can question their interest, or their instructiveness. And yet, what are the emotions that stir one as he reads of the visible sound waves described by several observers after moments of extra violent cannonading along the battle line.[8] Distinct bands were actually seen moving across the clouds with the known velocity of sound, or again, equally distinct against a clear sky. Such points of interest should escape no teacher of physics, for nothing can be more legitimate than enlisting the pupil's interest with illustrations of this kind.

Other problems in other fields are fully as numerous and as fascinating as those we have noted, but we will have to content ourselves with mere reference to some of them. What of the application of optical principles? At home we have protective lighting[9] based upon an ever-improving appreciation of the correct principles of illuminating engineering. Then again, American manufacturers have struggled heroically and with incomplete success to produce good optical glass. The student wants to know the reason for this endeavor—the reason for the failure—the necessity for such glass anyway. And who is to enlighten him if not the physics teacher. When he seeks to learn something about the submarine camera, he comes upon the stabilizing gyroscope.[10] He also finds that the search lamp is an optical instrument of high design, and that the manufacture and operation of the portable gasoline-motor-electric-generator search-lamp outfits embraces a wide field of activity and many physical principles.[11]

Even the teacher must be alert to keep up with only such phases of physical development due to the war as are published. There are new methods for testing mirrors for signalling purposes and special apparatus for measuring magnifying powers and the angle between the axes of binoculars. The Michelson interferometer finds use in finishing prisms, lenses and combinations. There are weathering tests for glass, new tests for parallax in the telescopic sights for rifles, new methods for determining the illumination and field of view of field glasses, special parallelism tests, micrometers for measuring prism angles before polishing, and new surface testing methods.[12] The refractometry and identification of glass requires special equipment and training.[13] Range finders have multiplied, even the prismatic binocular having joined the list by the simple addition of a calibrated disk by means of which the distance to an object of known dimensions can be determined.[14] Unfortunately all of these

[7] *Science Abstracts A*, No. 657, 1917. *Science Abstracts, A*, No. 658, 1917.

[8] *L'Astronomie*, July, 1917. *Scientific American*, November 10, 1917, p. 343.

[9] *Electrical World*, May 18, 1918, p. 1049.

[10] *Scientific American*, May 19, 1917, p. 483. *Trans. Illum. Eng. Soc.*, XII., 8, November 20, 1917, p. 396.

[11] *Trans. Illum. Eng. Soc.*, XII., 8, November 20, 1917, p. 357. *Elect. World*, December 9, 1916, p. 1169.

[12] *Science Abstracts, A*, 379, 1917.

[13] *Scientific American Supp.*, No. 2178, September 29, 1917, p. 198.

[14] *Scientific American*, January 12, 1918, p. 60.

latter devices are far too scarce. The industry concerned in their manufacture as well as the youth who may be called upon to use them, must be encouraged to the fullest possible extent, not only to win in the present war, but for the sake of the future. The recent condition has been aptly described by Professor Southall. Last December he pointed out that the British navy was almost without range finders at the opening of the war—that almost the entire optical industry had to be built up both in France and in England since that time. But what is of especial interest to the physics teacher is his statement that, "if the optical industries are to be encouraged and developed among us, not only now but in the years to come after the war, there will be an increasing need of trained and experienced men with more or less extensive acquaintance with the whole range of optics, both theoretical and applied."[15] Here is a demand and also an opportunity. Only recently has there been organized anything like a comprehensive series of courses in the various branches of geometrical and physical optics. For the first time an American university now offers complete courses in the "Theory of Modern Optical Instruments, Lens Design and Lens Testing, Manufacture of Optical Glass, Refractometry, Polarimetry, Physiological Optics, Photometry, Spectrophotometry, Colorimetry, Optometry, etc."[16] There is a new interest in the optics of vision due to the physical examination for military service, and at the same time we have corrective surgery of the eye, again based on physical principles.[17]

But to hasten on. Smoke screens on the sea had no sooner begun to shut out ordinary vision than there came the suggestion that the use of infra-red and ultra-violet lenses would make photography perfectly possible.[18] Surely this involves physical principles of interest to the student because of their increasing utility, if for no other reason.

New methods of photometry have had to be developed because of the growing military use of fluorescent and phosphorescent compounds.[19] Here the Purkinje effect again appears. Then again, the selenium cell has received such study that its sensitiveness has been increased a thousand fold.[20] Can the student escape the charming influence of such ideas as these developments afford? Can the teacher do less than encourage this interest to the fullest extent possible?

The war is responsible to a great extent for the fact that more attention was paid to illuminating engineering than to any other branch in the leading articles in the most important technical periodicals in 1917.[21] Here is a great field of applied physics just opening up. Its demands on the present-day teachers are evident. Its opportunities need not be discussed.

And so we could go on through the various divisions of physics. Under electricity, we meet our old acquaintance, the Hughes induction balance, now equally serviceable for locating shells buried in the earth and fragments embedded in the muscles of the human body. Coal shortage has pushed hydro-electric development. Food scarcity has aroused new interest in the electro-culture of crops. Magnetic surveys similar to

15 *Scientific American*, December 15, 1917, p. 455.

16 *Scientific American*, December 15, 1917, p. 455.

17 *Scientific American*, January 12, 1918, p. 53.

18 *Scientific American*, September 22, 1917, p. 207.

19 *Trans. Illum. Eng. Soc.*, November 20, 1917, p. 394. *Illum. Eng.* (Lond.), March 1917, p. 76. *Rep. Nat. Phys. Lab.*, 1915–16, p. 33.

20 *Trans. Illum. Eng. Soc.*, XII., 8, November 20, 1917, p. 395.

21 *Trans. Illum. Eng. Soc.*, XII., 8, November 20, 1917, p. 117.

those made for land and sea are now needed for the air.[22] Wireless telegraphy and telephony have advanced by leaps and bounds, and simple inductive telephony has reached a high degree of development in the very front lines of the opposing armies.[23] Electrical schools have opened up for the training of war-made cripples.[24] The radiodynamics of torpedo and boat control offers a field for study almost new. The use of the X-rays requires constructors, operators and doctors who have acquired the requisite fundamental principles in good courses in physics. Electrochemical processes in general are becoming American for the first time, and every citizen is continually being reminded in one way or another of the fact that the war is one of science, and that the reconstruction must likewise be one based on a knowledge of natural laws.

There is still another phase of our new development which makes a definite demand on the physics teacher. It is the part that women are to take in the life of the nation in the years to come. Whatever may be one's idea of equal suffrage, he must recognize the fact that a large portion of the burden of the world war is being borne by women. They are entering the industries; they are becoming electricians, machinists, chemists, in fact everything that man has wished to be solely. And with this awakening will undoubtedly come wide interest in the sciences fundamental to industrial activity. New economies have required more detailed explanations of the scientific methods of obtaining them. Household physics, though a comparatively recent term, has now for the first time come to have a real meaning. Surely the present war, however unpleasant it may be otherwise, will serve above all other things to hasten the happy era of better ideals, when the joys and burdens of the world will be more equally shared by its men and its women. Hence, the instruction of the girl as well as of the boy makes new demands on the teacher, and affords him widening opportunities for developing his subject as an integral part of the school curriculum, and thereby better himself by bettering every one else.

To enumerate additional problems brought to the physicist as a result of the war would be useless, but with the necessary increase in vocational education[25] will come the necessity for a more practical type of physics as presented to the elementary class. This suggestion is not meant in any way to disparage the more advanced type of research work, for it will be in greater demand than ever before, but, as always, the teacher must be the interpreter who shall spread abroad truths and thus justify the effort made in their discovery.

You well know that to include in such an attempt as the present one a comprehensive statement of such advances in physics as those which we are hoping may aid in winning the war, is futile. We do know, however, that advances are being made. We know something of the results. Those of us who are fortunate enough to have some knowledge of the details must remain silent because of military necessity. As recently expressed,

> Whatever startling developments have taken place during the year of 1917 are hidden behind the veil of the censor, and it remains for us to wait for the end of the war before a complete review can be undertaken.[26]

That the effect on physical research resulting from the present governmental co-

22 *Scientific American*, April 20, 1918, p. 355.

23 *Scientific American*, April 6, 1918, p. 305.

24 *Elec. World*, November 17, 1917, p. 955.

25 *Scientific American Supp.*, No. 2201, March 9, 1918, p. 149.

26 *Scientific American*, January 5, 1918, p. 7.

operation will be inestimable, can not be questioned. The great British National Physical Laboratory, which is the equivalent of our own Bureau of Standards, has been taken over from the Royal Society for government work alone.[27] In our own country among numerous organizations may be mentioned the expanding Engineering Council, which now proposes an affiliation with all of the national engineering bodies and technical societies in the United States, thus bringing to physics and allied branches applications of unprecedented scope.[28] Our Council of National Defense, together with the Bureau of Education and the States Relations Service of the Department of Agriculture have considered the mistakes of the Allies and have emphasized the fact that the people now receiving any scientific training will have special advantages after the war. As Dr. Claxton, Commissioner of Education, has said,

> When the war is over, whether within a few months or after many years, there will be demands upon this country for men and women of scientific knowledge, technical skill and general culture as have never before come to any country.[29]

We must supply men and women familiar with fundamental science not only for our own development but to replace the hordes from European countries now going down on the fields of battle.

Again, President Wilson has asked that the National Research Council be perpetuated "to stimulate research in the mathematical, physical and biological sciences."[30] An Inventions Section as an agency within the General Staff of the War Department has been organized, and it is not without great import to the whole field of physics teaching that the Science and Research division is headed by Professor Millikan.

Still another probable development, that can not but bring joy to the heart of every physicist, is the more or less universal adoption of the metric system with the readjustment succeeding the war. England has already admitted that Germany has gained in industrial efficiency by the use of this system.[31]

> So many hundreds of young Englishmen have gone to somewhere in France that Englishmen have seen a great light in the simple workings of the decimal and metric systems. They are urging the abolition of the needless, brain-wasting multiplication of units at home.[32]

To date twenty-eight of the greatest public bodies in the United Kingdom have advocated the adoption of decimal systems of coinage, weights and measures. It can be no different in this country. We are now manufacturing some of our munitions of war to metric measurements, and surely this is a movement in which physics teachers should be the leaders. Knowing its value, they have advocated it in a half-hearted sort of a way for many years, but now, unbidden, comes a demand and an opportunity. No single development could go further to establish in the mind of the public the idea that physics is a science of practical value—that its ways are the ways of efficiency. And hand in hand with this movement comes the proposal from Dr. Klotz for universal scientific symbols.[33]

We have already gone further than was necessary to draw the conclusion of the whole argument. What has been said of physics is applicable in many ways to other branches of science. But the tacit assumption throughout has been that physics is one of the most if not the most basic of sciences. This may be a doctrine not universally accepted, but we who advocate it

[27] *Scientific American*, October 20, 1917, p. 283.

[28] *Scientific American*, April 20, 1918, p. 355.

[29] *Scientific American*, September 1, 1917, p. 153.

[30] SCIENCE, May 24, 1918, p. 511.

[31] *Scientific American Supp.*, No. 2175, September 8, 1917, p. 149.

[32] *Elec. World*, July 7, 1917, p. 3.

[33] *Scientific American*, December 8, 1917, p. 435.

on the basis of something more than a superficial knowledge of its content, can do so with all sincerity. It is legitimate that we should struggle to make it as popular a science as may be without discarding its essentially rigorous methods, for, as Dr. Nutting has said, the typical product of slack methods is a slacker.[34] But difficulties will only serve to heighten its estimated value, once it becomes generally known that physics is good for something. In meeting the demand for such evidence, the physics teacher will find the greatest opportunity for his own development and that of his beloved science.

E. H. Johnson

THE IRWIN EXPEDITION OF INDIANA UNIVERSITY TO PERU AND BOLIVIA

In 1909 I summarized the knowledge of the distribution of South American fresh-water fishes in general. I dealt with the origin of the Pacific slope fish fauna in part in the following words:[1]

There are four distinct faunas on the Pacific slope of America between Cape Horn and the Tropic of Cancer. One of these is of common origin with that on the Atlantic slope, one is autochthonus and the other two are derivative from the Atlantic slope faunas opposed to them.

1. The fauna of southern Chili is essentially like that of Patagonia, and inasmuch as it is largely made up of marine forms entering fresh water, and fresh-water forms entering the ocean, it seems very probable that the species migrated from river to river along the coast from Patagonia to Chili or from Chili to Patagonia.

2. At the other extreme in the Rio Mezquital of the Transition Region and the Yaqui just to the north of it there is a fauna essentially like that of the Rio Grande east of them. As Meek has pointed out, the Yaqui and Mezquital have captured tributaries of the Rio Grande togther with the fishes in them, and the migration of Atlantic slope northern forms to the Pacific slope has been a passive one.

34 *Scientific Monthly*, May, 1918, p. 406.

1 Reports of the Princeton University Expeditions to Patagonia, III., 1909, p. 352.

Thus, types which in America north of Mexico have not succeeded in reaching the Pacific slope, have, within the Tropics, crossed the divide. . . .

3. The third fauna is the Mexican of the Rio de Santiago. This is undoubtedly the relict of an old fauna reenforced by a few immigrants from the north. It is here not a question of the origin of the fauna from an eastern one, but of an autochthonus development that has, on its part, contributed elements to the surrounding rivers. It passively contributed to the Atlantic slope fauna by having one of its small rivers captured by the Rio Panuco.

4. Of more particular interest is the origin of the fauna of western Peru and Ecuador and that of western Central America. Not enough is known of the fauna of the western part of Central America to attempt an explanation of its origin.

Concerning the Andean fauna I said in part, page 305:

The Andean region includes the high Andes on both slopes from Venezuela and Colombia to Chili. It is poor in species at any given point, but some of the genera have a large number of local adaptations or species. This region is distinctly marked off into three provinces.

1. The Northern includes the highlands of northern Peru, Ecuador, Colombia and Venezuela. This is the richest in species and distinguished by the genera *Arges*, *Cyclopium*, *Prenadilla* and the high development of *Chætostomus*. Its fauna is largely an ancient derivative from the lowland fresh-water fauna of Archiguiana.

2. The Titicacan, including the basin of Titicaca and neighboring streams, and possibly the land-locked basins of Bolivia, concerning which nothing is known, is distinguished by the genus *Orestias* and the absence of the genera distinguishing the northern province. Its fauna is largely an ancient derivative from the ocean.

3. The Southern is the poorest in species, characterized by the absence of everything but a few species of *Pygidium*, a genus which extends the entire length of the Andean region.

Further, p. 373, I said:

The points of strategic importance for ichthyic chorology in South America are, therefore, western Colombia and Panama, Guayaquil and Peru to the Amazon, across the Andes. . . .

Most of my time since the publication of the monograph quoted, in fact, since its preparation several years earlier, has been de-

voted to working out the details of a plan then made. I have had the cooperation of various institutions and individuals.

As part of this scheme I urged in Science, N. S., Vol. XXII., No. 549, pp. 553–556, the exploration of Panama before the canal should be completed. This work was well done by the late S. E. Meek and S. F. Hildebrand, under the auspices of the Field Museum and the Smithsonian Institution.

To examine conditions in Colombia I traveled in 1913 from Cartagena up the Magdalena to Girardot, thence to Bogotá in the eastern Cordilleras, thence across the Magdalena valley to Ibagué, across the central Andes to Cartago, up the Cauca valley to Cali, and across the western Andes to Buenaventura on the Pacific, thence up the Pacific slope stream San Juan, across the divide and down the Atlantic slope rivers, Quito and Atrato, to the starting point. My assistant during this trip, Mr. Manuel Gonzales, later visited the Atlantic slopes of the easternmost Andes between Bogotá and Barrigona, and Hermano Apolinar Maria, the efficient director of the Instituto de la Salle of Bogotá, had collections made for me in the Llanos east of Bogotá.

Mr. Hugh McK. Landon and Mr. Carl G. Fisher later enabled Mr. Arthur Henn, now in medical service with the American Expeditionary Forces, and Mr. Charles Wilson, also now in medical service, to explore the Patia and Atrato San Juan Basins of western Colombia, and still later Mr. Henn was enabled by Mr. Landon and Indiana University to explore the western slope of Ecuador, especially the Guayaquil basin.

Various attempts to secure the means to carry the work southward have failed until this spring, when the American Association for the Advancement of Science made me an appropriation of five hundred dollars, the Indiana University made a similar appropriation, and Mr. William G. Irwin, of Columbus, Indiana, sent the university a check to cover the larger part of the estimated expenses of the Peruvian part of the field work. The University of Illinois is providing the expenses of an assistant, Mr. William Ray Allen, who is to devote his time largely to parasites, and Miss Adele Rosa Eigenmann, a medical student in Indiana University, is to go as a volunteer assistant. Submarines being willing, we are to sail June 21 and the expedition is to be known as the Irwin Expedition.

As far as field work may be planned in advance, it is the intention to cross from the Pacific to the Amazon basin in at least three points in Peru:

First, Pacasmayo over Cajamarca to Balzas on the Marañon. The fishes of Pacasmayo are known in part at least through collections made by Osgood, of the Field Museum. Nothing is known of the fauna of the Cajamarca valley and very little of that of the upper Marañon.

Second, Callao over Oroyo, Cerro de Pasco to Huanuco. An attempt will be made to secure the faunas of the Rimac, of the High Andean Lake Hunin, and of the head waters of the Huallaga.

Third, Mollendo, Arequipa, Puno, Cuzco and Rio Urubamba. Attempts will be made to get as complete a representation as possible of the fauna of the Andean Lakes Titicaca and Poopo, and of the Rio Urubamba of the Ucayale basin.

Fourth, etc., some work will be done in Bolivia and Chili, but this will depend largely upon whether additional sums become available.

The expedition as definitely planned ought to give us as fair a notion of the Pacific slope fauna from the desert of northern Chili to Ecuador as we have of the Pacific slope of Ecuador, Colombia and southern Panama, as well as of the fauna immediately east of the crest of the Andes in Peru.

I am indebted to the president and trustees of Indiana University, who have made it my duty to devote myself to the work as outlined for the time needed to complete it.

Carl H. Eigenmann

SCIENTIFIC EVENTS

SCHOOL FOR OPTICAL MUNITION WORKERS

The War Industries Board authorizes the announcement that some of the fundamental

items required by the army and navy in war times are technical in nature and would ordinarily not be thought of by the casual observer. Such an item is optical glass, which is used in telescopes and instruments that serve in the direction and control of firing large and small guns and in engineering and surveying operations. The artilleryman without fire-control instruments can accomplish little; the submarine without its periscope is of small value; the airplane without a camera can make no maps of the enemy's country. Therefore, optical glass is very essential in military instruments of different types.

The optical glass problem in this country has been solved and there is now available manufacturing capacity for optical glass sufficient to supply the Army and Navy; but the skilled labor necessary to work up this glass into lenses and prisms, and to assemble these into finished instruments is not adequate. This situation is so serious that unless steps are taken to provide this labor the soldiers and sailors will be only partially equipped with necessary fire-control instruments.

To meet this situation the Ordnance Department of the Army is establishing in Rochester, N. Y., a training school for operatives on precision optics. The school is to be located at the Mechanics Institute, in Rochester, and the large optical manufacturing firms in Rochester are providing instructors and aiding in the installation of the necessary grinding, polishing, and centering apparatus.

Courses in the different branches of this industry will be given and extended over a period of six weeks. A living wage will be paid to those who take these courses. On completion of the course the student will be in a position to enter one of the optical munition factories and be competent to perform certain of the operations required.

Work of this kind on the grinding, polishing, centering, assembly, and inspection of lenses and prisms for optical systems is not heavy, and is well suited for young women who desire to do their share on war-munitions work. Many young women in this country have been knitting and doing such other work as they are able to do to aid our soldiers and sailors, but have desired an opportunity for more responsible work. Not every woman can become a nurse, and there are still great numbers of young women whose energies are not fully utilized and who are not doing their bit toward winning the war. A good opportunity to do this is afforded by the optical training school at Rochester. Work in optical munitions is most urgent and is of highly responsible character. Optical munition workers are well paid and are contributing directly to American success in this war.

In England two training schools of this nature were established some time ago and have proved most successful. As a result, the manufacture of optical munitions in England is well in hand, and many of the responsible positions are held by young women, not formerly employed, who are serving their country most effectively in this capacity.

Details regarding the courses of instruction can be obtained from Dr. Barker, president of the Mechanics Institute, Rochester, N. Y. The largest factories are located in Rochester, Buffalo, and New York, N. Y.; Boston and Southbridge, Mass.; Pittsburgh, Pa., and Dayton, Ohio.

SUMMER WORK AT THE LABORATORIES OF THE BUREAU OF FISHERIES

Work at the Fairport laboratory is proceeding with the least possible interruption this summer. Through the cooperation of the permanent employees of the station arrangements for working quarters and living accommodations for a limited number of investigators have been made. Professors C. B. Wilson, Emmeline Moore, and H. S. Davis continue investigations of aquatic insects, plants, and protozoan parasites of fishes, respectively, in relation to fish culture in ponds.

Dr. Albert Mann, of the Bureau of Plant Industry, has been detailed by the Secretary of Agriculture, at the request of the Secretary of Commerce, for special work on the diatom flora of the Woods Hole region. Portions of the laboratory of the Woods Hole station are in the possession of the Navy Department, but laboratory facilities are available for a limited

number of investigators. Superintendent W. H. Thomas has been designated acting director of the laboratory for the season. Dr. George T. Moore, of the Missouri Botanical Garden, assisted by F. B. Dieuaide, will conduct experiments on the production and utilization of algin. Professor Edwin Linton, of Washington and Jefferson College, will continue investigations of the parasites of fishes and the food of flounders and other fishes.

The Beaufort laboratory having been turned over to the Navy Department, no work will be done there this summer.

THE AMERICAN INSTITUTE OF MINING ENGINEERS

In an effort to increase the scope of their war service, the American Institute of Mining Engineers will meet in Colorado during the week of September 2, to take up vital problems of immediate importance. Mining engineers from every section of the country will attend. During the meeting, trips are to be made from Colorado Springs to the Cripple Creek district, Pueblo, the Leadville district and Boulder. The week's session will open in Denver on the second of September, and will that evening move to Colorado Springs, which will be the principal headquarters for the duration of the meeting.

This is the first meeting of the entire institute in Colorado since 1896, and an appropriate entertainment program is being planned by the several hundred Colorado members. One of the special features of the entertainment will be an auto drive to the top of Pikes Peak. The sections of Colorado to be visited are rich in many war minerals of importance including ferro alloys, radium, molybdenite ores and pyrites.

Those who are directing the plans for the Colorado meeting are as follows: Committee in charge, Spencer Penrose, chairman, A. E. Carlton, chairman finance committee, George M. Taylor, vice-chairman, J. Dawson Hawkins, secretary. Denver Committees: (Arrangement) Dave G. Miller, Frank Bulkley, Geo. E. Collins; (Entertainment) F. H. Bostwick, F. E. Shepard, Howland Bancroft, B. P. Morse, J. G. Perry; (Finance) T. B. Stearns, Richard A. Parker, T. B. Burbridge.

THIRD SUMMER MEETING OF THE MATHEMATICAL ASSOCIATION OF AMERICA

It is announced in the *American Mathematical Monthly* that the third summer meeting of the Association will be held by invitation of Dartmouth College at Hanover, New Hampshire, on Friday and Saturday, September 6–7, 1918, in conjunction with, and following, the summer meeting of the American Mathematical Society. A joint dinner will be arranged for Thursday evening, September 5, and at a joint session on Friday morning the subject of the mathematics of warfare is to be treated by men now actively engaged in government service.

During the sessions of the association on Friday and Saturday, Professor Florian Cajori, of the University of California, will deliver his address, as retiring president, on "Plans for a History of Mathematics in the Nineteenth Century"; Professor W. F. Osgood, of Harvard University, will speak "On the Mathematical Formulation of Physical Concepts and Laws as treated in the Calculus"; and Professor F. L. Kennedy, of Harvard University, will give a paper on "Some Experiments in the Teaching of Descriptive Geometry," the discussion being led by Dean O. E. Randall, of Brown University. Other features of the association's program will be announced later.

For a session on Friday members are invited to submit papers on topics of their own choosing. Abstracts of such papers in a form suitable for publication in the Secretary's report of the meeting should be sent to Professor R. C. Archibald, Brown University, chairman of the program committee, not later than August first, in order to be approved by the committee in time for publication in the printed program; authors will please state the time necessary for reading their papers. No other announcement will be made until the program is mailed to members about the middle of August.

The committee on arrangements, Professor J. W. Young, chairman, announces that Dartmouth College will open one of its dormitories for the accommodation of attending members.

A separate entrance, or at least a separate floor, will be provided for ladies or married couples. Meals will be furnished under the auspices of the college at reasonable rates. The rates for the occupancy of dormitory rooms will probably be one dollar per day per person. Persons desiring to stay over Sunday and Monday for the purpose of making excursions into the neighboring hills and mountains can probably be accommodated.

SCIENTIFIC NOTES AND NEWS

SIR WILLIAM CROOKES, O.M., celebrated his eighty-sixth birthday on June 17.

MR. HORACE LAMB, F.R.S., professor of mathematics in the University of Manchester, has been appointed Halley lecturer at Oxford University for next year.

DR. WILLIAM S. THAYER, of the Johns Hopkins University, now a colonel in the National Army, has been made a foreign member of the French Academy of Medicine.

A SECTION of Anthropology in the Division of Medical Records in the Office of the Surgeon General, was created on July 23, 1918. Major Chas. B. Davenport, Sanitary Corps, N. A., has been designated as the officer in charge. The functions of this section are to be: To secure the highest quality of the measurement of recruits and of identification records as done by the Surgeon General's Office for the purposes of the War Department; to assist, as called upon, in the analysis and synthesis of the statistics compiled from medical records; to care for and help analyze physical examination records; to care for and classify identification records, and to assist the War Department in all questions about racial dimensions and differences.

PROFESSOR E. V. HUNTINGTON, president of the Mathematical Association of America, has taken leave of absence from Harvard University and with the rank of major in the national army is assigned to statistical study under the chief of staff with residence in Washington.

PROFESSOR A. D. COLE, professor of physics at Ohio State University, is in Washington for the summer, engaged in research work in the Bureau of Standards.

MR. W. L. CURRIE, of Glasgow, has been elected president of the Pharmaceutical Society of Great Britain.

THE Association of Military Surgeons of the United States will hold its annual meeting for 1918 at Camp Greenleaf, Fort Oglethorpe, Ga., on October 13 and 15, under the presidency of Medical Director George A. Lung, of the U. S. Navy.

BY request of the Secretary of War and the Secretary of the Navy the National Research Council has formed a committee on explosives investigations composed of Lieutenant Colonel W. C. Spraunce, Jr., Ordnance, National Army, nominated by the Chief of Ordnance of the Army; Lieutenant Commander T. S. Wilkinson, United States Navy, nominated by the Chief of Ordnance, United States Navy, and Mr. L. L. Summers, representing the War Industries Board, with Dr. Charles E. Munroe, dean of the faculty of graduate studies of the George Washington University, as chairman. The functions of the committee as officially defined are: (1) To survey the investigations on explosives now under way and to keep closely in touch with their subsequent progress. (2) To gather and communicate to the proper military and naval authorities all information available in regard to such investigations. (3) To bring to the attention of the proper military and naval authorities proposals for supplementary investigations relating to explosives, and to arrange for the prosecution of such investigations by the civilian bureaus of the government, by industrial companies and by universities and endowed research institutions. The office of the committee is in the building of the National Research Council at 1023 Sixteenth Street, Washington, D. C.

DRS. C. E. FERREE and G. RAND, of Bryn Mawr College, presented a paper at the fifty-fourth Annual Convention of the American Ophthalmological Society on July 10 on "The Inertia of Adjustment of the Eye for Clear Seeing at Different Distances." A method and apparatus were described for testing for

fitness for aviation and other vocations for which speed and accuracy of adjustment of the eye for clear seeing at different distances are a prerequisite.

In accordance with plans for cooperation of the Bureau of Chemistry and the Bureau of Fisheries on problems of preparation and preservation of fishery products for food, Dr. F. C. Weber, of the Bureau of Chemistry, and Drs. G. G. Scott and W. W. Browne, of the College of the City of New York, temporary assistants of the Bureau of Fisheries, have begun work for the summer at Perkins Laboratory, Gloucester, Mass., where facilities and cooperation are afforded by the Gorton-Pew Fisheries Co.

UNIVERSITY AND EDUCATIONAL NEWS

The University of Chicago has received from Mr. La Verne Noyes a gift of $2,500,000, to be used in the education of soldiers and sailors and their descendents after the war. In addition the fund provides for the perpetuation of instruction in American history and the public duties of citizenship.

Columbia University is a beneficiary under the will of Major Eugene Wilson Caldwell, of the United States Medical Reserve Corps, from two trust funds upon the death of life tenants to support a foundation for general educational work. Dr. Caldwell died in Roosevelt Hospital from burns received while experimenting with X-rays. His estate was valued at more than $150,000.

The Kansas City Veterinary College, after an existence of twenty-seven years, during which it has graduated nearly 1,700 men, has decided to abandon the field of veterinary education. It has transferred to the Kansas State Agricultural College its records and good will, and made arrangements with that institution to take over its students as far as possible and agreeable to them.

The Department of Chemistry of the State College of Washington, Pullman, Washington, announces the establishment of a fellowship, to be devoted to research on the extension of the chemical uses of magnesite, paying $600 a year.

Dr. C. W. McCampbell, for eight years a member of the department of animal husbandry of the Kansas State Agricultural College, is the new head of the department, succeeding Professor W. A. Cochel, who has resigned.

Professor J. H. Ransom, after eighteen years in Purdue University, has accepted the professorship of chemistry and director of the chemical laboratories in Vanderbilt University, Nashville, Tenn.

W. V. Lovitt, Ph.D., Chicago, of the mathematical department of Purdue University, has been appointed associate professor of mathematics in Colorado College.

The electors to the Harkness scholarship in geology in Cambridge University have recommended that the scholarship for women for 1918 be awarded to Majorie E. J. Chandler, Newnham College.

Sir Charles Parsons has accepted the office of president of the Polytechnic School of Engineering, London, in succession to the late Mr. Charles Hawksley.

Dr. Maud Kinnaman, of Washington, N. J., has been made head of the new medical college at Vellore, India.

DISCUSSION AND CORRESPONDENCE

THE FUNDAMENTALS OF DYNAMICS

Most discussions of elementary mechanics refer to variations in point of view and especially to variations of emphasis which are all equally logical and all fully understood by careful students of the subject. Therefore, discussions of elementary mechanics usually say a great deal to "put over" a mere grain of edification, and Professor E. V. Huntington's recent discussions of elementary mechanics in Science and in the *American Mathematical Monthly* is no exception to the general rule. From the most favorable point of view, Professor Huntington's discussion is much ado about nothing; but from our point of view it

is much worse than that. If we were not convinced that Professor Huntington is definitely mistaken in several important matters we would not, for a third time, take part in the discussion.

1. Professor Huntington urges the use of the term *standard weight*, the *weight* of a body in London in "pounds,"[1] instead of *mass*. Now what we call the mass of a body is independent of time and place, it is an invariant[2] relation between the given body and the standard kilogram (a piece of metal), and extraneous and confusing ideas would be involved in the term *standard weight*, because this term implies location and a relationship between the given body and the earth. How awkward it would be, for example, to be obliged always to speak of the distance d between two points (x, y, z) and (x', y', z') as $[(x-x')^2+(y-y')^2+(z-z')^2]_{\frac{1}{2}}$. This function is an invariant, and the most useful name or symbol for it is a name or symbol which carries no redundant suggestions as to particular axes of reference, *and this would be true even if we had always to make use of particular axes of reference in the measurement of d.* The word *mass* is widely used by physicists and chemists for an idea which is independent of time and place and which does not involve any relationship with the earth (this is true even though mass be determined by weighing), and it is simply out of the question to use for this idea the term *standard weight* with its redundant and misleading suggestions.

2. To be unfriendly to the term *mass* and to prefer the term *standard weight* is of course a small matter; but Professor Huntington seems to go much deeper than mere terminology. He insists, for example, on the equation $F/F' = a/a'$ as THE fundamental equation of dynamics, although several correspondents in SCIENCE have called his attention to the fact that acceleration not only varies from force to force for a given body *but also from body to body for a given force.* Both of these fundamental modes of variation must be formulated as fundamental equations of dynamics. Professor Huntington states[3] that the variation-from-body-to-body-for-a-given-force is logically derivable from the variation-from-force-to-force-for-a-given-body, and the object of the following discussion is to make it clearly evident that Professor Huntington's statement is not true.

[1] The "pound" here means the pull of the earth on a one-pound body in London.

[2] No consideration is here given to variations of mass as recognized in the recent developments of the principle of relativity.

Given three bodies A, B, and C, and three identifiable forces a, b and c. Let the acceleration of each body due to each force be *observed*, the results being shown in the accompanying table. Let us suppose that the table has been

TABLE OF OBSERVED ACCELERATIONS

		Bodies		
		A	B	C
Forces	a	25	30	35
	b	50	60	70
	c	75	90	105

extended so as to include a great many different forces and a great many different bodies, then a careful inspection of the table would lead to the following generalizations:

(*a*) If one force produces twice as much acceleration as another force when acting on a given body, then the one force produces twice as much acceleration as the other force when acting on *any body whatever.*

(*b*) If one body is accelerated twice as much as another body under the action of a given force, then the one body is accelerated twice as much as the other body under the action of *any force whatever.*

The experimental fact (*a*) makes it convenient to define the ratio of two forces as the ratio of the accelerations they produce when acting on a given body, because this ratio is the same for all bodies.

That is

$$\frac{F}{F'} = \frac{a}{a'}, \tag{1}$$

[3] SCIENCE, March 3, 1916, page 315.

where a is the acceleration of a given body produced by force F, and a' is the acceleration produced by force F'.

The experimental fact (b) makes it convenient to define the ratio of the masses of two bodies as the inverse ratio of the accelerations produced by a given force, because this ratio is the same for all forces.

That is

$$\frac{m}{m'} = \frac{a'}{a}, \qquad (2)$$

where a is the acceleration of body No. 1 and a' is the acceleration of body No. 2, both produced by a given force, and m and m' are the masses of the respective bodies.

We prefer to define mass quantitatively in terms of the operation of weighing by a balance scale and to look upon equation (2) as an experimental discovery; but in any case equations (1) and (2) are independent and they are the fundamental equations of dynamics.

Equation (1) applies to a given body, and pure logic would not even know of the existence of another body, so that equation (2), inasmuch as it refers to at least two bodies, can not be a logical consequence of equation (1). It is surprising to us to have Professor Huntington refer[4] to the above table of observed accelerations in support of his statement that equation (2) is a logical or mathematical consequence of equation (1). Of course we have not observed these accelerations, but in the last analysis they are dependent on observation and upon nothing else.

3. Professor Huntington's statements as to systematic units are very much like most current text-book statements touching this matter. "Fundamental units may be chosen at pleasure"—so all of our talking physicists say, mentioning only the evident condition that material standards thereof must be carefully preserved. Working physicists, however, know that the fundamental quantities must be susceptible of very accurate measurement under all sorts of conditions and in all kinds of relations *because the definition of a derived unit can not be realized with greater accuracy than the fundamental quantities can be measured.*

[4] SCIENCE, March 3, 1916, page 315.

Think of the years of confusion in electrical measurements when the theoretical ohm could not be produced with greater accuracy than, say, one per cent., but when almost anybody could make resistance measurements to, say, a hundredth of one per cent! When we recall that old nightmare we are inclined to smile at the childish pleasure with which many teachers talk about choosing fundamental units. Indeed, one fundamental unit would be enough if certain measurements, which would then be fundamental, could be made with sufficient accuracy. This important condition of *accurate realization of derived units* makes it undesirable to use the pull of the earth on a one-pound body in London (or on a one-gram body) as a fundamental unit in any universally practicable system. As a matter of widest practise the use of the unit of force as a fundamental unit is out of the question. We admit, however, and here we differ from some of our colleagues in physics, that the C.G.S. system (or the F.P.S. system) is less convenient than the foot-slug-second system in some fields of engineering.[5]

4. It is extremely amusing to read Professor Huntington's naïve suggestion that a unit of force might be preserved in the form of a standard spring. This is laughable for two reasons, namely, (a) because the pull of the earth on a one-pound body in London is perhaps as invariable as its mass so that no standard spring is needed to preserve a unit of force, and (b) because, as every working physicist knows, the most carefully "aged" springs grow very perceptibly softer in time. Tempered steel and phosphor bronze and fused quartz are unstable substances.

5. We are at a loss to understand the significance of Professor Huntington's efforts to establish order in the fundamental view points of mechanics except on the assumption that he has felt, somewhat vaguely, the central fallacy,

[5] We publish in a current number of the *Bulletin* of the Society for the Promotion of Engineering Education a brief and simple discussion of this subject, a discussion which we think may show the way to a general agreement among writers on mechanics.

namely, (*a*) the willing agreement among all technical writers to use the word *weight* to designate the earth pull on a body, followed by (*b*) a careless reversion to the usage of the coal man and the acceptance of his meaning when he sends a bill for 2,000 pounds weight of coal! Let it be understood that the coal man's weight is precisely the physicist's and the chemist's mass. The balance scale measures mass, it does not and can not measure force in any precise sense until the ratio of the local value of gravity to the value of gravity in London is known.

Wm. S. Franklin,
Barry MacNutt

THE CANONS OF COMPARATIVE ANATOMY

In a recent number of Science[1] Professor W. P. Thompson refers to a recent letter of mine to that journal. He maintains that the assertion on my part that he made use of the Canons of Comparative Anatomy through ignorance to reach an erroneous conclusion is inaccurate. This seems to be contrary to the facts, since Professor Thompson on his own showing is culpable either of inexcusable ignorance or deliberate misrepresentation. He emphasizes the value of the genus *Vaccinium* as a type illustrative of the relations between two main forms of vessel in the angiosperms, namely, the one with scalariform perforations and that with porous perforations. Had his acquaintance with the anatomy of *Vaccinium* been more complete, he would have realized that the type of vessel found in the Gnetalian genus *Ephedra* is also present there. Contrary to Mr. Thompson's statement, moreover, vessels of the *Gnetum* type prevail in the higher angiosperms rather than in the lower ones, being universal, for example, in the Compositæ and extremely common in the monocotyledons. It is unfortunate that Professor Thompson either through ignorance or intention has failed to emphasize the presence of the *Gnetum* type of vessel in the angiosperms, particularly as in many cases it has in that large group a mode of origin similar to that described by him in the case of *Gnetum*. It thus appears that his contention that the *Gnetum* and *Ephedra* types of vessels are fundamentally different in origin from those of the angiosperms is without foundation in fact, since both these types are actually present in quite high angiosperms. Professor Thompson's attitude is further highly inconsistent, since in earlier publication he has called attention to the resemblances between the wood rays of *Ephedra* and those of certain angiosperms, and to the occurrence of nuclear fusions in *Gnetum* which he compares with that found in the case of the endosperm nucleus of the angiosperms.

E. C. Jeffrey

1 N. S., Vol. XLVII., No. 1221.

WHOLE-WHEAT BREAD

To the Editor of Science: As a contribution to the discussion "Shall We Eat Whole-wheat Bread,"[1] may I quote from the findings of a special committee appointed by the Royal Society of England, to study this matter,[2] as follows:

The bread now in use is prepared from grain milled to 90 per cent. with the addition of other cereals. After investigation, a committee of the Royal Society has issued a report on the following questions: (1) What gain, if any, in food value accrues from a rise in the milling standard from 80 to 90 per cent., and does the dilution of wheat flour with other cereals modify the food value of the bread? (2) What would be the effect on the health of the consumption of such breads? (3) How far would such breads prove acceptable? Experiments were made with wheat flour, extracted to 80 and to 90 per cent. The analytical work was done in the biochemical department of the University of Cambridge and in the physiological laboratories of the universities of Glasgow and London. The diet consisted of 800 gm. of bread with butter, cheese, minced or potted meat, fruit jelly, milk and sugar, tea or coffee, and in one case beer was taken as a beverage. This dietary yielded about 3,680 calories a day. *The effects were remarkably uniform.*[3] Bread made from the 80 per cent. flour yielded for nutrition 96.1 per cent. of the energy contained in the diet; bread made from 90 per

1 "The Conservation of Wheat," Science, Vol. XLVII., No. 1218, p. 429; Science, N. S., Vol. XLVII., No. 1210, p. 228, March 8, 1918.

2 Copied from the *J. Amer. Med. Assn.*, Vol. 70, No. 22, p. 1619, June 1, 1918.

3 The italics are my own.

cent. flour, 94.5 per cent. The loss of energy with the second bread was greater (5.5 per cent.) than with the first (3.9 per cent.). The intestinal secretions were considered to contribute largely to this. The feces with the 90 per cent. bread were more bulky, and the coarser particles of this bread produced a greater stimulation of the secretion of the intestine. The increase in the bulk of the evacuation is not an evil and in the case of many is even an advantage. As to the nitrogenous constituents, the average digestibility was 89.4 per cent. in bread made from flour extracted to 80 per cent., and 87.3 per cent. in that extracted to 90 per cent. In most of the cases there was a slight gain in body weight with both breads. Thus a *greater proportion of the energy of the grain*[3] *is available for human consumption when flour is milled at the 90 per cent. scale than on the 80 per cent. scale. The increase would extend the cereal supply of energy for the country for more than a month.* Against this is to be set the loss of protein in the offal as food for pigs. Another set of experiments were made with bread made from flour consisting four fifths of wheat extracted at 80 per cent., and one fifth of maize. At first the flavor of the maize was commented on, and there was in some cases disturbance of digestion, attended sometimes with diarrhea, and more often with constipation; but these symptoms passed off. The general conclusion is that bread made with the addition of maize flour was as digestible as bread made without it, and it was well digested by children. The addition of maize made practically no difference in the utilization of energy and nitrogen. Observations were made at a canteen on the dietetic effect[3] and *on the palatability of bread made from flour containing four fifths of wheat extracted* to 90 per cent., and one fifth of other permitted cereals (10 per cent. barley, made up to 20 per cent. with maize and rice, or rice alone). It was found *to be palatable* and *never to cause indigestion.*

These conclusions seem to strongly support my former statements that the "attack on the higher extraction flours is unmerited" and "that higher extraction flours are not normally harmful" and also when these flours are used more generally over the country "more grain will be released for the allied armies."

R. ADAMS DUTCHER

SCIENTIFIC ACTIVITY AND THE WAR

THE Italian mathematician G. Vivanti opened the preface of his book entitled "Equazioni Integrali Lineari," 1916, with the following words:

> While our sons fight valorously to liberate Europe from the Teutonic yoke it devolves on us, whose age and strength do not permit to offer arms to our country, to work for its scientific emancipation. A *national* science is an absurdity and he would be foolish who would refuse a scientific truth because it arose from beyond the Alps or the sea; but the work of scientific exposition and publication can be and ought to be national. Who does not recognize a German treatise by its minute and sometimes wearisome care of particulars, an English by its good-natured and discursive tone, a French by its form which is sometimes a little vague but always suggestive and elegant?

These words of an Italian scholar may be of especial interest at this time when so many of us are considering the question of how to render the most effective service to our country. It is interesting to note that Vivanti emphasized scientific exposition and publication as a means towards securing scientific emancipation. While scientific investigation should always occupy the foremost place in a permanent scientific program, it must be admitted that there is danger in fixing our attention too completely on the most important element in our scientific progress. Our students should not have to feel that the great majority of the best expository works relating to their subject are to be found only in the language of a people of low ideals imbued with a morbid desire to dominate the world at any cost.

From a quotation found on page 9 of the May, 1918, *Bulletin of the American Association of University Professors,* it appears that the German professors are still very active in the production of scholarly works, while those of England and France are devoting themselves much more completely to direct service connected with the war. This direct service is probably a natural concomitant of the high ideals which prevail in these countries, but it is evident that it points to the possibility "of winning the war in a military sense, only to find ourselves dominated by German knowledge and German science!"

The preparation of scholarly works of the

highest possible order at the present time is thus seen to be a patriotic service, which should be considered very seriously by those who are in position to render it. The uncertainty as regards prompt publication only adds to the credit due to those who are undertaking such service at the present time as far as opportunities connected with direct work for winning the war are not jeopardized thereby. It is perhaps reasonable to expect that scientific publications in the English language will find a wider market after the war than before, and that the public will then have acquired a higher appreciation of the nation's need of science.

It is perhaps especially important to emphasize the need of a vigorous development of pure science at this time in order that the applied sciences whose active development is being encouraged by immediate needs may not suffer later on account of a lack of theoretic impulses. The fact that applications do not always appear along expected lines was recently emphasized by H. Lebesgue in a review published in the *Bulletin des Sciences Mathématiques,* April, 1918, where he refers (page 94) to the fact that from the time elliptic functions were first discovered about a century and a half ago, mathematicians decided that they should have practical uses. Up to the present time the only applications of elliptic functions are the applications of mathematicians, who still await the first confirmation of their *a priori* idea as regards their practical usefulness.

G. A. Miller
University of Illinois

SCIENTIFIC BOOKS

Patenting and Promoting Inventions. By Moïs H. Avram, M.E., New York. Robert M. McBride & Co. 1918. Pp. 166. $1.25, postage extra.

By reason of the comprehensiveness, balance and candor of its brief discussions, this little volume seems to deserve clear differentiation from the familiar and misleading booklets designed merely to promote the soliciting business of firms advertised thereby. Beginning with its preliminary chapter (a general survey) entitled Why Inventors Fail, and throughout the seven successive chapters covering in outline the evolution of the patent system, the United States patent practise, the patenting of inventions abroad, patent attorneys, and expert investigations extending even into the very practical collateral questions of manufacture, markets and financing, there is however maintained a natural emphasis upon the need, shared by the inventor and the investor, for advice and assistance on the part of those technically qualified. In proportion as this need seems both real and permanent, in the complex industrial organization from which there seems no possibility of a return, such emphasis seems timely.

In his references to those who have to do with the work and administration of the Patent Office the author is not ungenerous. The uncertainties at present inherent in the development of inventions are neither exaggerated nor concealed. But not every reader may be able to share the author's apparent conviction that a timely resort to expert private advice would notwithstanding save the day for the inventor or the investor. Disregarding the fact that there are, of course, experts and "experts," it may be suggested, by way of supplement, that so long as there shall continue at the Patent Office a rapid flux in its inadequate and disheartened force, apparent defects in its organization and in its informative resources and an atmosphere of legal technicality, without due time or incentive for a broad consideration of scientific, economic or equitable considerations, there can be little hope for such service and security as the patent system was designed to afford. To the reviewer, it is accordingly a matter of gratification to find that the need for collective effort, involving some legislative action, is appreciated, even though it is not stressed in the work under review.

Although perhaps hardly pretending to the solidity of a work of reference, this volume seems sufficiently comprehensive and exact to justify the inclusion, in any subsequent edition, of such an index as would facilitate

ready reference to numerous minor topics—such as reissues, disclaimers, forfeitures, interferences—which are discussed in brief but effective subordinate paragraphs.

BERT RUSSELL

RECOMMENDATIONS OF THE AGRICULTURAL ADVISORY COMMITTEE

SECRETARY HOUSTON has received the recommendations of the agricultural advisory committee reported at the conclusion of its meeting in Washington, June 27 to July 2. The following are among the most important subjects considered by the committee:

1. Indorsement of Henry C. Stuart, chairman of the agricultural advisory committee, for appointment on the War Industries Board as representative of agriculture.

Following is the text of the resolution:

Resolved, That the full committee indorses the action of the executive committee in asking for the appointment of the Hon. Henry C. Stuart, the chairman of the Committee, upon the War Industries Board.

2. Facts were submitted to the committee showing that the harvest of spring wheat would come at a season when soldiers would probably just be entraining for military services, and they would therefore be lost to the wheat harvest in the spring wheat region. The committee, therefore, passed a resolution, to be presented to Provost Marshal General Crowder, asking that temporary deferred classification be granted to the men called July 22–27, before their entrainment, that they might help in the harvest before leaving home, rather than to report at their cantonments and then be furloughed back, thus saving expenses to the government and preventing a loss of time for the men.

3. A full discussion was had of the unusual car shortage and the delays in the shipments of live stock and grain during the past winter, resulting in large financial loss to the producers. Attention was called to the fact that transportation conditions were still unsatisfactory and the Department of Agriculture and the Food Administration were requested to take up the matter again with the Railroad Administration, with the view of insuring relief in these matters. A subcommittee on transportation was appointed, of which Henry C. Stuart was chairman, to act with the two departments in placing this matter before the Director General.

4. Consideration was given to criticisms that had been made in regard to the application by division heads of the rules and regulations of the War Industries Board regarding wool. There seemed to be ground for believing that some of the interpretations of the rules worked a hardship on the wool growers. A subcommittee was appointed to look into this matter and make such recommendations as seemed to them necessary to a readjustment of the matters complained of, and a recovery of losses incurred, if any.

5. The committee devoted a large portion of its time during the first three days of its session to a discussion of the grades and prices of wheat in which Mr. Hoover and members of his staff, with representatives of the Grain Division and the Bureau of Markets of the Department of Agriculture, participated. Practically all of the recommendations of the committee were provided for in the final draft of the announcement issued July 1.

A subcommittee had formulated an expression of suggested explanations of terms and conditions that were thought to be helpful in giving the farmer a clear understanding of the regulations and his personal status in their administration.

These suggestions were heartily indorsed by the full committee and the Food Administration.

6. A resolution was passed giving indorsement of the plan of the Bureau of Animal Industry for stamping out tuberculosis in cattle. Suggestions were made that some of the plans might be slightly modified in the matter of facilitating the disposition of tubercular animals.

7. WHEREAS the Department of Agriculture has submitted for our consideration a proposal for the elimination of certain less essential types or designs of farm machinery and parts thereof, giving as a reason therefor that because of the war

demands the allotment of steel for the manufacture of farm machinery must be limited to the amount strictly necessary to enable our farmers to maintain crop production, and that the multiplicity of types and designs now existing places an unnecessary burden upon steel mills in preparing steel and iron therefor; and whereas we believe the reasons given are just and valid and that the demand upon us is in line with the demands made upon other industries: Therefore be it

Resolved, That we indorse the schedule of eliminations submitted by the Department of Agriculture, with certain minor changes, with the understanding and with the assurance on the part of those who have prepared the schedule that no change in design of any implement has been made which will lessen its strength or efficiency, and no machine or implement has been eliminated which is essential for the efficient production of agricultural products in any extensive region, and the work performed by which can not be as efficiently done by other machines, the manufacture of which shall be permitted. We recommend, however, that measures be taken to afford full protection to farmers owning machines of types eliminated by requiring that manufacturers make and place on the market repair parts for eliminated machines or eliminated parts of machines for a length of time equal to the average normal life of such machines or parts.

The committee passed resolutions urging the Department of Agriculture to insist on the standardization of parts of farm implements, such as cultivator teeth, mower and harvester guards, mower and harvester sections, threads on bolts, skeins on wagons, surface cultivator knives and many other parts on which patents have expired. It was the opinion of the committee that this would result in very material economy in every way and increased convenience to the farmer in securing implement parts.

8. After discussing the prevalent prices of farm machinery and the advances made during the past three years, the committee passed a resolution asking for an investigation at the earliest possible date, into the cost of manufacturing farm implements and asked that the industry be required to operate on a basis of cost plus a reasonable profit.

9. The committee recorded its appreciation of the good work done by the Food Administration in increasing the consumption of potatoes, thus partially relieving the stress arising from the production of a heavy spring crop in the south, with large storage stocks held over in the north.

The promotion of war gardens was commended, as it was believed by the committee that the results not only showed a larger supply of fresh vegetables but converted many acres to the growing of staple crops that helped to increase the total food supply and to lessen transportation difficulties.

The Department of Agriculture was commended for its work in the selection and breeding of potatoes in the various potato-growing sections.

Much interest was expressed in the dehydration of vegetables, especially potatoes, and it was recommended that this work should be followed up.

Record was filed, briefly reviewing the poultry conditions of the country, showing that although the price of poultry had not advanced in keeping with the price of feeds, more eggs have been shipped and stored than at the same time in 1917, this being partly due to the early warm season and partly to the patriotic adherence to the industry in spite of adverse conditions.

A resolution was passed expressing the opinion of the committee that the vegetable forcing industry was important, and so blended with the forcing of plants for field crops, that the industry should be fostered and protected as far as the exigencies of the war may permit.

10. On reports of members of the committee from the west and south where wheat has already been harvested, regarding the highly efficient service rendered by the Farm Labor Division of the United States Department of Agriculture and the Federal Department of Labor, in the mobilization and distribution of harvesters to the wheat fields of the south and west up to the present time, the committee asked for a continuation of this service to the completion of the harvest in the spring-wheat region.

11. The following resolution was adopted by the committee:

Whereas absolute war necessity and shortage of wheat for export has required that, in the exchange milling of his own wheat, the farmer be restricted to a supply of flour equal to his household needs and those of his farm employees for 30 days; and

Whereas the present crop prospect seems to make this necessity less acute, be it

Resolved, That the Food Administration be requested to remove this restriction as early as conditions will allow.

12. The committee was of the opinion that groundrock phosphate and acid phosphate should have the same freight classification as agricultural lime, taking an increased freight rate of one cent a hundred pounds, instead of an increase of 25 per cent., as applied to general commodities, and it was directed that request be made to the Director General of Railroads that the desired classification be granted.

13 Resolutions were passed by the committee favoring:

(1) Regulation of the use of mill feeds by the mixers of proprietary feeds, so as to secure to the dairyman the benefits of the efforts of the Food Administration to lower the price of mill feeds.

(2) Regulation of the manufactories of mixed feeds.

(3) Equitable distribution of mill feeds.

(4) Use of sugar substitutes in ice cream manufactories.

(5) The disallowance of sugar to manufacturers of ice cream failing to comply with reasonable standards of butter fat and solids not fat.

(6) Purchase of dairy products by Army and Navy.

(7) Expression of appreciation to the Food Administration for the publicity given to the economic value of milk.

(8) Recommendation to the government to extend the standardization of dairy and other agricultural products.

(9) Commendation to the market report service by the Bureau of Markets.

The subcommittee on dairy products presented to the tariff department of the Railroad Administration an explanation of the hardship upon the small shipper of milk and cream, because of the minimum charge of 50 cents on any individual shipment.

The regulation was promptly modified so as to nullify the application of a minimum charge.

SPECIAL ARTICLES

THE RELATION OF THE RATE OF BLOOD FLOW THROUGH THE MEDULLA OBLONGATA TO THE AMPLITUDE AND FREQUENCY OF RESPIRATORY MOVEMENTS

Although the relation to respiratory movements of the changing concentrations of carbon dioxide in the blood, and of afferent nerve impulses from the lungs to the medulla oblongata has long been recognized, a third factor entering into the equation, *i. e.,* the rate of blood flow through the medulla oblongata, has received but little consideration. Haldane[1] mentions the rate of blood flow as one of the factors, but the emphasis, as is natural in pathology, is placed mainly on the general disturbances of the circulation.

Some years ago I repeated Sir Astley Cooper's old experiment of ligating permanently both common carotid and both vertebral arteries close to their origin in dogs. The experiments were done aseptically and the animals allowed to live. The chemical analyses of the brains of these animals were published by Waldemar Kock and S. A. Mann.[2] The general results of the ligation were similar in all essential respects to those noted by Leonard Hill.[3] Hill remarks that in one dog, there was preliminary acceleration of the respiration following the ligation of the four arteries.

I noticed respiratory disturbances in some dogs, and one in particular attracted my at-

[1] "Text Book of General Pathology," edited by M. S. Pembrey and James Ritchie, London and New York, 1913, chapter on Respiration; Organism and Environment as Illustrated by the Physiology of Breathing, New Haven, 1917, pp. 5–6.

[2] Mott's "Archives of Neurology and Psychiatry from the Pathological Laboratory of the London County Asylums," London, 1909, IV., pp. 211–12; Studies from the Rockefeller Institute for Medical Research, X., 1910, p. 38 of the reprint.

[3] "Physiology and Pathology of the Cerebral Circulation," London, 1896, p. 123.

tention. When lying quietly at rest, there was no apparent change in the respiration. No graphic records or measurements of the minute volume were taken. But when the dog was urged to rise and walk about, it at once began to pant violently. On lying down again, the panting ceased. Other dogs with normal cerebral circulation did not pant except after much greater exertion.

Hill states that none of his dogs died after ligation of the four cerebral arteries, but he does not mention the age of his dogs. I have found that vigorous, full-grown dogs survive the ligation indefinitely, but half-grown pups and old dogs usually succumb within twenty-four hours. I have seen half-grown pups lie unconscious for several hours, sometimes panting violently, and sometimes making ineffectual movements of locomotion with the fore limbs. Attempts to rouse them from this state were unsuccessful, and they were usually found dead the next morning.

Hill remarks that there must be a certain blood pressure resulting in the flow of a certain amount of blood through the medulla oblongata in order to provoke respiration. My experience tends to confirm Hill's conclusion. It is a striking thing to see an animal with failing respiration at a low blood pressure improve rapidly when the pressure is artificially increased.

In the dogs with restricted cerebral circulation, there was no apparent deficiency in the rest of the systemic circulation in those which recovered. Nor is there any reason to suppose that there was any change in the blood which would decrease its power of carrying either oxygen or carbon dioxide. It does not seem improbable that, in the dog with the marked respiratory disturbance, one would have found a somewhat greater concentration of oxygen and a somewhat lower concentration of carbon dioxide in the blood than in dogs with normal circulation. The condition in the medullary center itself, in which carbon dioxide might tend to accumulate in somewhat greater concentration than usual, would seem sufficient to account for the dyspnœa on moving about. A lower concentration of carbon dioxide in the blood would be the natural result of the forced respiration. In cases of shock resulting from abdominal wounds on the battle field, in which there was no deficiency of the systemic circulation prior to the wound, it does not seem necessary to assume the production of any large quantities of acid in the body to account for the lower concentration of carbon dioxide in the blood of such patients. It seems sufficient to suppose that, as the systemic blood pressure falls progressively lower, there would be a deficient blood supply to the respiratory mechanism in the medulla oblongata. The natural result would be an increase in the volume of respiration, and a decrease in the concentration of carbon dioxide in the blood. This would not in itself be a sufficient reason for postulating acidosis as a causative factor in the early stages of shock. Whatever acid might accumulate in the tissues might result, as Haldane[4] suggests, from the deficient supply of oxygen to the tissues.

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ON THE HYDROLYSIS OF PROTEINS IN THE PRESENCE OF EXTRANEOUS MATERIALS AND ON THE ORIGIN AND NATURE OF THE "HUMIN" OF A PROTEIN HYDROLYSATE

In a recent paper McHargue[1] attempts to show that the nitrogen distribution of casein is not appreciably altered when hydrolyzed in the presence of five times its weight of starch providing that the hydrolysis is continued for only 12–15 hours. McHargue reaches a conclusion which is decidedly at variance with that reached by myself[2] and by Hart and Sure,[3] *i. e.*, that the presence of carbohydrates seriously vitiates the nitrogen distributions of a Van Slyke analysis and he explains the difference in the findings by his shorter hydrolysis. However, he makes several astonishing

1 J. S. McHargue, *J. Agr. Res.*, Vol. 12, pp. 1–7 (1918).

2 R. A. Gortner, *J. Biol. Chem.*, Vol. 26, pp. 177–204 (1916).

3 E. B. Hart and B. Sure, *J. Biol. Chem.*, Vol. 28, pp. 241–49 (1916).

4 *Loc. cit.*

statements in his paper to which it seems worthy of calling attention.

He states:[1]

In the footings of the different analyses it will be noted that the 12-hour digestions give footings more than 2.5 per cent. over 100. In the 15-hour digestion the footing is good, while in the 24- and 48-hour digestions the footings are 2.75 per cent. less than 100, thus indicating that the 12-hour experiments were probably not completely hydrolyzed; whereas the 15-hour digestion was sufficient to bring about complete hydrolysis and the 24- and 48-hour experiments were over-digested to the extent that nitrogen was lost.

One can but wonder where he secured such reasoning, or it is needless to point out that not more than 100 per cent. of the original nitrogen can be present in a protein hydrolysate even if complete hydrolysis has not taken place and the literature of proteins shows that no nitrogen is lost by overhydrolysis. Gortner and Holm[4] recently hydrolyzed fibrin for 6 weeks and obtained a recovery of 99 per cent., while 201 hours' hydrolysis showed a recovery of 100.7 per cent. the figures being, in both instances, within the experimental error of the analyses.

However, his most astounding conclusion is that the nitrogen in the insoluble residue obtained from the casein starch digestion "*is in an inert form and its estimation should not be included in the humin determination*," with the result that he ignored the presence of nitrogen in this fraction in calculating his nitrogen distribution. Unfortunately he does not tell us how much nitrogen remained in this fraction[5] so that we can not recalculate his data, and as a result all of his laborious analyses are worthless. I use the word "astounding" in the above sentence advisedly, for in all of the protein literature I can find no reference to the black humin of protein hydrolysis which does not define it as insoluble, unreactive and inert, and any one who has studied its properties knows well that it is one of the least reactive of the chemical substances ordinarily met with, resembling in much of its behavior ordinary bone black. The humin of protein hydrolysis is a black, granular, noncrystalline substance, insoluble in the ordinary organic solvents, somewhat soluble in alkalis from which solution it is precipitated again by acids, and, in short, the true humin of protein hydrolysis agrees in every respect *as regards physical properties* with the material which McHargue discards and refuses to call humin.

Then again, the nitrogen of the fraction which he discards certainly belonged to the original casein, for his starch was practically nitrogen-free. How then can he claim that hydrolysis in the presence of starch does not alter the nitrogen distribution? This nitrogen which he discards belonged to the original protein molecule and should be included in the starch hydrolysates if it is included in the original casein analysis with which the starch hydrolysates are compared.

As I have shown previously (2), hydrolysis in the presence of carbohydrates causes a very considerable increase in the insoluble humin fraction and this increase is due to both chemical and physical causes. The nitrogen in the true humin of a protein hydrolysate has its origin almost wholly in the tryptophane molecule[6] and the reaction by which it is formed appears to be the condensation of tryptophane with an aldehyde or ketone. When carbohydrates are present the acid causes the formation of furfural which condenses with the tryptophane to form a "humin." However, furfural itself has the peculiar property of polymerizing(?), in the presence of 20 per cent. hydrochloric acid, to a black insoluble substance with the result that a large mass of porous black material is formed in the hydrolysate and this material, presumably through *physical* means, retains a very considerable amount of non-tryptophane nitrogen which normally would not appear in the humin fraction. *Perhaps* these latter forms of nitrogen would not be present in the black mass formed from the furfural in as great a quan-

[4] R. A. Gortner and G. E. Holm, *J. Amer. Chem. Soc.*, Vol. 39, pp. 2736–2745 (1917).

[5] He does give the per cent. of nitrogen in the black material but not the weight of the black material.

[6] R. A. Gortner and G. E. Holm, *J. Amer. Chem. Soc.*, Vol. 39, pp. 2477–2501 (1917).

tity in a twelve-hour hydrolysate as in a forty-eight-hour hydrolysate, but there is no question but that a part of the tryptophane nitrogen would be in this fraction.

It is of interest to note that McHargue obtained no "insoluble humin" for the twelve-hour hydrolysate of casein to which no carbohydrate had been added, and that his "histidine" fraction is in excess of that reported by other analysts. This observation accords beautifully with the idea of Gortner and Holm[6] that an aldehyde or ketone must be present to cause insoluble humin formation from tryptophane and that when insufficient aldehyde is present and the hydrolysis is not sufficiently prolonged the tryptophane will be (in part) precipitated by phosphotungstic acid and augment the "histidine" fraction [cf. Gortner and Holm[4]].

However, all of this discussion, pertinent as it may be, would be trivial were it not for the fact that other workers may be led to accept McHargue's conclusions and thus cause a further waste of money and energy in pursuing an illusive will-o'-the-wisp.

In the introduction to his paper McHargue seems to argue that Van Slyke's method may be applied directly to feeding stuffs without necessarily securing inaccurate results. Even if we should grant that the presence of carbohydrates *per se* did not vitiate the results, and all available evidence is contrary to such a conclusion, there would still remain other forms of nitrogen than proteins in the feeding stuffs which must necessarily appear in the various fractions and be wrongly calculated as amino acids. For example, Steenbock[7] reports the presence of stachydrin in alfalfa and this substance would be calculated as "histidine" in a Van Slyke analysis. I have elsewhere[2] fully discussed this point and therefore have no hesitation in making the following statements: (1) Proteins can not be hydrolyzed with 20 per cent. hydrochloric acid at atmospheric pressure in the presence of a considerable quanity of carbohydrates without appreciably altering certain of the nitrogen fractions of a Van Slyke analysis, and (2) a Van Slyke analysis applied to feeding stuffs, containing as they do non-protein nitrogenous compounds, gives no valid index as to the presence or absence of any individual amino-acid.

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[7] H. Steenbock, *Sci. Proc. Soc. Biol. Chem.*, XXVII., 1916; *J. Biol. Chem.*, Vol. 29 (1917).

THE ACADEMY OF SCIENCE OF ST. LOUIS

At a meeting held on May 20 Professor Francis E. Nipher stated that he had been making observations on local variations in the electrical potential of the earth, due to local thunderstorms. The large masses in the Cavendish apparatus are connected with a wire passing through a window in the second story of the physics building to the earth. The wire is in contact with wet grass in the yard below, and with metal rods which are pushed down into wet ground to a depth of about 15 inches. The lightning rod which grounds a high metal tower on the building, which was formerly used for wireless telegraphy, has been broken near the earth, and a gap of about two inches has been made in the rod. This rod can at any time be put in metallic contact with the large masses, by means of a knife switch. On several occasions during storms, sudden changes in the attraction of the large masses upon the suspended masses within the metallic shield have occurred, which it seems impossible to explain except as due to enormous changes in the potential of the large masses, due to local changes in the electrical potential of the earth. Previous results show that this would change the gravitational attraction between the masses.

N. M. Grier,
Recording Secretary

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